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An Infectious Approach to Biofabrication

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Advances in nanotechnology offer significant improvements in a range of applications including lightweight materials with greater strength, increased energy efficiency from electronic devices, and better sensors for a range of medical and environmental uses. However, these advances require the development of systems for the design, modeling, and synthesis of nanoscale materials. Interestingly, many biological molecules function on this scale and possess unique properties that impart the ability to assume defined conformations and assemblies as well as interact with specific chemical or biological substrates. Studies in our laboratory utilize RNA plant viruses as templates for the “bottom up” self-assembly and patterning of novel nanomaterials. Such viruses represent very simple macromolecular assemblies consisting of a single molecule of nucleic acid packaged by many copies of an identical coat protein. Using molecular genetic and chemical methods we have introduced specific structural features onto the virus backbone that direct its surface assembly and functionalization with a range of inorganic materials. Virus-assembled surfaces display an ~80-fold increase in surface that significantly enhances the activities of functionalized materials. Additionally, these virus surfaces provide a robust platform for traditional “top down” production methods, including lithography, sputtering, and atomic layer deposition. The integration of “bottom up” virus assembly methods with “top down” manufacturing processes represents an integrated approach for the production of novel nanoscale materials and devices with enhanced activities.